REMARKS

This application was filed with twenty-nine claims. Claims 1-38 and 52-55 were previously cancelled. Claims 46 and 61 have been cancelled in this paper. Claims 39-43, 45-47, 49, 51, 56 and 59-61 have been rejected. Claims 39, 41, 45, 47, 49, 51, and 56 have been amended. Therefore, Claims 39-43, 45, 47, 49, 51, 56 and 59-60 are pending in the Application. Reconsideration of the application based on the remaining claims as amended and arguments submitted below is respectfully requested.

Amendments to Drawings

The drawings are objected to under 37 CFR 1.83(a) because the dopants within the cathode (claim 61) must be shown or the features canceled from the claim. Applicant has canceled Claim 61, rendering this objection moot.

Claim Rejections - 35 U.S.C. § 102

Claims 45-47, and 51 have been rejected under 35 U.S.C. § 102 as being anticipated by Geis et al. (U.S. 5,713,775). In response, Claim 46 has been canceled. Claims 45, 47 and 51 have been amended. Reconsideration of this rejection is respectfully requested based on the amendments to the claims and on the arguments set forth below.

Geis discloses a diamond cold cathode emitter that is substitutionally doped with nitrogen. In particular, Geis discloses a "rough" back contact for the diamond

layer. According to Geis, the use of substitutional doping with nitrogen can enhance the injection of electrons from a conductor (such as a metal substrate) into a diamond cathode. (See col. 5, lines 43-51) Although, Geis makes reference to a "downward band bending" at col. 6, lines 44-48, Geis says nothing about using an enhancement means in the emitter structure to cause a preferential emission of higher energy electrons from the cathode to the anode. Geis says nothing about thermal-electric energy conversion. This phenomena is achieved in the present invention to provide direct thermal-electrical energy conversion. This preferential emission of higher energy electrons is shown in Figs. 1a, 1b, 2, and 3 of the present application. In Fig. 1b, the bending of the diamond cathode conduction band is shown, providing a curved energy barrier that extends across the cathode to the diamond-vacuum interface. Fig. 2 shows the results of providing this curved barrier as compared to a linear barrier. Although the number of electrons emitted are the same, the curved barrier increases the energy of the electrons emitted. As explained in Applicant's specification, by causing the diamond emitter to preferentially emit higher energy electrons, the average energy level of the replacement electrons in the cathode is lower. When the device is connected to a source of electrical energy and when the cathode is thermally connected to a heat source, a net transfer of thermal energy results, causing a cooling of the heat source.

Geis says nothing about the use of a diamond emitter structure as an electronic cooling device or as a device for transferring heat from a thermal energy source. Geis says nothing about providing a means to implement such a device.

Although, as noted by the Examiner, some transfer of thermal energy from the cathode to anode may be inherent in the operation of a generic electron emission device, efficient operation of a diamond emitter as an energy conversion device requires preferential emission of higher energy electrons. Referring to Figs. 2A and 2B of Geis, a downward shifting of the conduction band is shown in Fig. 2B, as caused by application of a reverse bias. In Figs. 2A and 2B of Geis, a slight curvature of the conduction band near the metal-cathode interface is shown, with a downward shifting of the linear portion of the band. This curvature could be caused by conventional space-charge effects. In any case, there is no illustration or discussion in Geis of a cathode conduction band curvature that provides the enhanced emission of high energy electrons as shown in Applicant's Fig. 2. There is no illustration or discussion in Geis of a cathode conduction band curvature that is usable to effect direct thermal-electric energy conversion. Accordingly, Claim 45, as amended, and dependent Claims 47 and 51, as amended, are not anticipated by Geis.

Claim Rejections - 35 U.S.C. § 103

Claims 39, 40, 45-47, and 51 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Tanaka et al. (U.S. 5,984,752) and Niigaki et al. (Niigaki) (U.S. 5,959,400). In response, Claim 46 has been canceled. Claims 39, 45, 47, and 51 have been amended. Reconsideration of this rejection is respectfully requested based on the amendments to the claims and on the arguments set forth below.

Tanaka describes in col. 17, line 45-col. 20, line 15, various embodiments of devices that use conventional thermoelectric cooling in which electrons flowing from a cathode to a second electrode resulting in a cooling of the cathode and a heating of the second electrode. As specifically stated at col. 18, lines 1-3, the cooling is based on the well-known Peltier effect, by which a DC current across two dissimilar materials causes a temperature differential. The heating/cooling can be reversed by reversing the current flow and the amount of cooling is a function of current flow. What Tanaka does not disclose is enhancement means for causing a curvature of the conduction band or a device that includes a power supply applying an electrical bias of sufficient potential to cause, in cooperation with a curvature of the cathode conduction band, preferential emission of higher energy electrons from the cathode through the vacuum and deposition on the anode. Applicant's device provides higher efficiency cooling by increasing the average energy of the emitted electrons without having to increase current flow. These limitations, not taught by Tanaka, are in Claims 39 and 45 as amended.

Niigaki only discloses a diamond field emitter for use in an electron tube. There is no teaching of direct thermal-electric energy conversion using enhanced emission of high energy electrons.

Accordingly, independent claims 39 and 45 as amended, and dependent claims 40, 47, and 51 should be allowable.

Claims 41-43 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka et al. (U.S. 5,984,752) and Niigaki et al. (Niigaki) (U.S. 5,959,400), in further view of Kumar (U.S. 5,399,238). Claim 41 has been amended to include the limitation that the cathode further comprises a conduction band and means to cause a curvature of the conduction band to enhance preferential emission of higher energy electrons thereby to enhance transfer of thermal energy from the cathode to the anode. As noted above with respect to claim 39, this structure and mechanism are not taught by Tanaka or Niigaki. Kumar '353 discloses methods of fabricating flat panel displays, not thermal-electric energy conversion. Accordingly, independent claim 41, as amended, and dependent claims 42-43 should be allowable.

Claim 49 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Tanka et al. (U.S. 5,984,752) and Niigaki et al. (Niigaki) (U.S. 5,959,400), in further view of Kumar et al (Kumar) (U.S. 5,614,353). Claim 49 is dependent on claim 45. As discussed above, claim 45 as amended defines a method of thermal – electrical energy conversion using preferential emission of higher energy electrons, a step not taught by the cited references.

Claims 56, 59, and 61 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka et al. (U.S. 5,984,752) and Niigaki et al. (Niigaki) (U.S. 5,959,400), in further view of Tavkelidze (U.S. 6,495,843). Claim 61 has been canceled. Claim 56 has been amended to include the limitations that the cathode has a conduction band and emission enhancement means to curve the conduction band and cause preferential emission of higher energy electrons. Neither Tanaka, Niigaki, nor Tavkelidze teach this. Claim 59 is dependent on claim 56 and should be allowable for the same reason.

Claim 60 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka et al. (U.S. 5,984,752), Niigaki et al. (Niigaki) (U.S. 5,959,400), and Tavkelidze (U.S. 6,495,843), in further view of Kumar et al. (Kumar) (U.S. 5,614,353). Claim 60 is dependent on claim 56 and should be allowable for the same reasons discussed above.

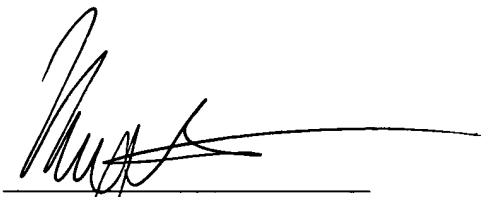
Applicant has commented on some of the distinctions between the cited references and the claims to facilitate a better understanding of the present invention. This discussion is not exhaustive of the facets of the invention, and

Applicant hereby reserves the right to present additional distinctions as appropriate. Furthermore, while these remarks may employ shortened, more specific, or variant descriptions of some of the claim language, Applicant respectfully notes that these remarks are not to be used to create implied limitations in the claims and only the actual wording of the claims should be considered against these references.

Pursuant to 37 C.F.R. § 1.136(a), Applicant petitions the Commissioner to extend the time for responding to the March 23, 2005, Office Action for three months from June 23, 2005, to September 23, 2005. Applicant encloses herewith a check in the amount of $510 made payable to the Director of the USPTO for the petition fee.

The Commissioner is authorized to charge any deficiency or credit any overpayment associated with the filing of this Response to Deposit Account 23-0035.

Respectfully submitted,



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